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ECOPROFILE FOR BUILDINGS
A METHOD FOR ENVIRONMENTAL CLASSIFICATION OF BUILDINGS

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ABSTRACT

The goal of sustainable development will be impossible to achieve without realignment of value creation by business and the public sector. The environmental impacts of building activities are serious. There is a need for new competencies, better information about the environmental attributes of buildings, and suitable tools with which to achieve better eco-efficiency in practice. An aggressive commitment to developing and spreading the use of the EcoProfile method will provide a cost-efficient and attitude-changing environmental policy tool. The method can prove a key tool for owners, tenants and other interest groups who accept that the challenge of greater eco-efficiency can be used to secure competitive advantages and costs savings. The EcoProfile method provides a basis for greater understanding by owners and interested engineers and consulting professionals.
The classification shows that the tool is capable of meeting a number of demands felt by owners, a tool for continuous improvement of existing buildings and a guide in design and refurbishment, and an aid in complying with the demands of government, market and interested parties.
The proposed method of classification of buildings, EcoProfile for Buildings, has been developed by the concerted efforts of a wide range of experts and institutions and has been tested on eleven pilot structures during 1995.

1. BACKGROUND

Commercial buildings are a major part of Norway's real estate. Offices account for about 31 million square meters of which one third were build after 1970. At the turn of the century there where about 50 different building materials to choose between, to day there are more like 50.000. The building activities generate about 3,5 million tonnes of waste and building running costs each year account for 35 % of Norway's total energy consumption. Building materials, ventilation and cleaning routines all impact on our health. Recent focus on indoor environment and "sick structures" shows that seemingly identical buildings may have entirely different characteristics

from an environmental point of view. The social cost of poor indoor climate in Norway have been estimated at 1 to 2 billion dollars a year.

A project "Green Working Life, Green Management Program" was initiated by the ministry of Environment in 1991 and transformed to a foundation in 1995, GRIP (Green Working Life in Practice). GRIP's mandate is anchored in the Governments follow-up of agenda 21. This "Environmental Action Program for the 21st Century" was adopted by the UN Conference on the Environment in Rio de Janeiro in 1992 and identifies the key cause of the steady deterioration of the global environment as the non-sustainable production and consumption patterns, especially in the industrially developed countries. One of GRIP's objectives is to develop methods and tools that raise the level of understanding of the markets so that purchasing decisions can be seen in an all-embracing life cycle perspective [1].
In light of the significance of the building industry's environmental impact and contribution to the national economy and the significance that buildings and homes play in our health and well-being it seems helpful to develop a primary tool for charting environmental attributes of buildings in a life cycle perspective.
At the opening of the Vision Eureka at Lillehammer in 1994, it was announced that the Ministry of Environmental had decided to establish a branch Committee for the development of a national standard environmental assessment method for buildings [2]. The method could be seen as a parallel to a voluntary system of eco-labelling of consumer products. The commercialisation will increase the environmental awareness of the construction industry and enhance the market pull for greener practice. The branch Committee objective was to draw up guidelines for development of a system of environmental assessment of buildings.

This involved evaluating:
1. need for environmental assessment inclusive consultative input from relevant users, organisations, etc.
2. impacts of environmental assessment with respect to existing laws and regulations, existing rating practices etc.
3. desirable development in Norway compared to development in Europe in general
4. requirements for final design of methodology and practical steps
5. implementation of method in market inclusive who should carry out environmental assessment, accreditation procedures if necessary, cost level, governmental demands regarding scheme, etc.

To secure effective contacts to the industry and users the development of the method was presented in a number of media exposures and daily papers and professional journals and has been discussed at many meetings and seminars within the industry organisations and in building owner circles.

2. CHANGING ENVIRONMENTAL POLICY DEMANDS NEW COMPETENCIES

In recent years the Norwegian authorities have stressed the implementation of measures that demand expanded producer liability and have established trade contacts in several sectors and waste categories. Regulation have also been passed concerning voluntary participation of industrial concerns in an environmental management and audit program (EMAS), providing support for the work of establishing criteria for the Nordic marking scheme (Swan).

Building and construction have often been dismissed as conservative when it comes to responding to the environmental call. One of the reasons the industry has been conservative may be the expertise and educational background of its leaders. Traditionally it has been dominated by technical people with little sympathy for social economics or environmental dynamism. It has also been limited by

- much of the information and know-how that research projects generate is not quickly enough disseminated to the marked to prevent new wrong decisions from being taken
- today's costs of waste disposal, transport and energy are not adequately non-ambiguous signals to the industry regarding how it should built and operate commercial buildings on a life cycle basis.
- the government has been little active in integrating means with policies in regard to acreage, infrastructure and buildings.

3. INTRODUCTION TO ECOPROFILE FOR BUILDINGS

Building activities, building management, and acreage use all cause severe environmental strains on society. The traditional perception of environmental problems in the building and construction industry has been connected with indoor climate and the impacts on the external environment due to energy consumption, resource usage and pollution. Such factors as locality adoption, building styles and local area usage are themes that have crept higher on the agenda in recent years, in addition to the relationship between building and users. Contractors are showing increase interests in waste handling, waste sorting at source, recycling and reuse in connection with building activities. Factors such as the working environment and safety are already implemented in the contractors internal control systems and are also perceived as key environmental factors by the owners.
The "cradle to grave" doctrine has been adopted for evaluations and recommendations. It has primarily been focused on the owner's need for a classification of environmental attributes of pre-existing buildings, but an eye has been cast to the principles of environmentally correct planning. It is beneficial if the tools for environmentally correct planning and environmental classification of

buildings can be developed integrally since the final product is a direct consequence of the planning involved.
The EcoProfile method augments other adequate foundation for assessing buildings like NS 3424 (Specification of costs in building projects), NS 3424 (Condition survey of construction work) and NS 3454 (Annual costs of buildings). EcoProfile for Buildings sums the knowledge contained above and should in any practical implementation be included in an overall evaluation. It is important that environmental attributes are tired in with economic factors, both revenues and outlays, at least in principle, for otherwise there will be a risk environmental assessment of buildings not achieving its deserved leverage in the market.

4. INTERNATIONAL DEVELOPMENT

In England the Building Research Establishment took the initiative for developing a practical method of environmental assessment of buildings, introducing in 1990 what it called the BREEAM method [3].

A number of development projects have sprung up internationally that replicate the BREEAM initiative. Without reviewing the many international projects in detail a few organisations have considered the field actively:

- US Green Building Council
- University of British Columbia, School of Architecture(Canada)
- L'Agence de l'Environment er de la Maîtrise de l'Energie(France)
- Brite-Euram Programme (EU)
- International Council of Building Research Studies and Documentation (CIB)

There is also much activity in the field elsewhere in Scandinavia. Nordic Council of Ministers has founded associated projects.

5. THE ECOPROFILE METHOD

The work started in 1994 to develop a method of environmental classification of existing commercial buildings whose aim was to be used in connection with:
- purchase and conveyance of existing buildings
- rehabilitation and refurbishment

The method was also intended for use as a yardstick and guide for design of new buildings.
The method needed to meet the following requirements:

- foster environmental advance by practical action
- offer good usage for scientific method
- be sufficiently simple and cheap to be widely adopted
- be transparent in the sense that underlying data was easy to verify

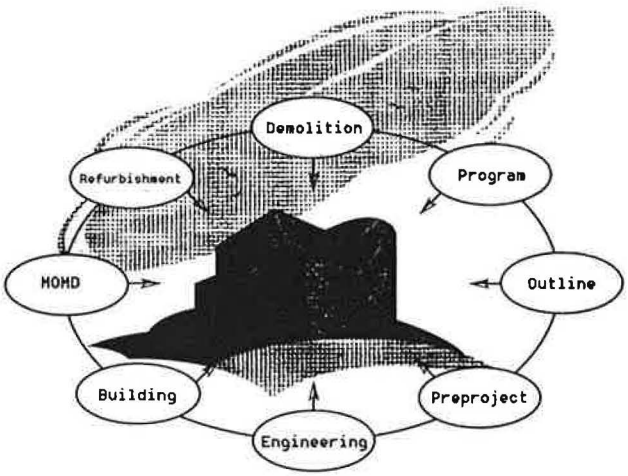

Figure 1 EcoProfile method can be a help during all stages in a building's life cycle.

EcoProfile is a method based on classification of a number of variables associated with the building as well as its management, and the building in use. It is a method considering the building as a whole. By weighting the significance of the 142 variables which are classified in four main areas it is possible to construct a EcoProfile that shows the building's environmental characteristics.

The EcoProfile method classifies a building in four main areas:

Energy area, which covers all questions concerning the building's overall energy consumption, is divided into eight subcategories which are; energy consumption, building specifics, heating, ventilation, hot water, lighting, cooling, outdoor systems. This main area comprises of 41 variables divided on these subcategories.

Indoor environment area comprises of 55 variables of significance for the building's indoor climate factors. This area has seven subcategories; materials, ventilation, heating and cooling, lighting, noise, cleaning and others.

Pollution area covers 55 variables of significance for the impact the building has on the external environment. This area has five subcategories; emissions to air, discharge to water, solid waste, noise and potential pollution.

Outdoor environment area comprises of 21 variables of significance for the land plot, the building's location and qualities seen from an environmental perspective. This area has tree subcategories; outdoor conditions, local conditions and traffic.

Some of the building properties will be significant for more than one main area. Ventilation is one example that impacts both on energy and indoor environment. Both these main areas therefore contain ventilation variables. Each main area, however, must be considered separately and not compared with others. The EcoProfile method has so far been based on a classification of parameters in three quality levels (1 - 3,5 - 6). For quantitative data simple algorithms will assign the appropriate points relative to the declared scale, while for none-quantifiable data the number of the checked items will be defined on a relative position on the scale.

Once the method was developed it needed to be tested. A classification of eleven pilot projects was carried out at the end of 1995, figure 2. Eight existing office buildings, two office blocks under design (building 2 and 5) and one school (building 11) were considered. These buildings represented design epochs from 1874 to 1996 (measured by year of building) and the heated areas varied from 1.700 to 17.000 square meters. The number of people working in the various buildings ranged from 50 to 550. The aim was to harvest experience and to develop knowledge about collecting environmental data for buildings.

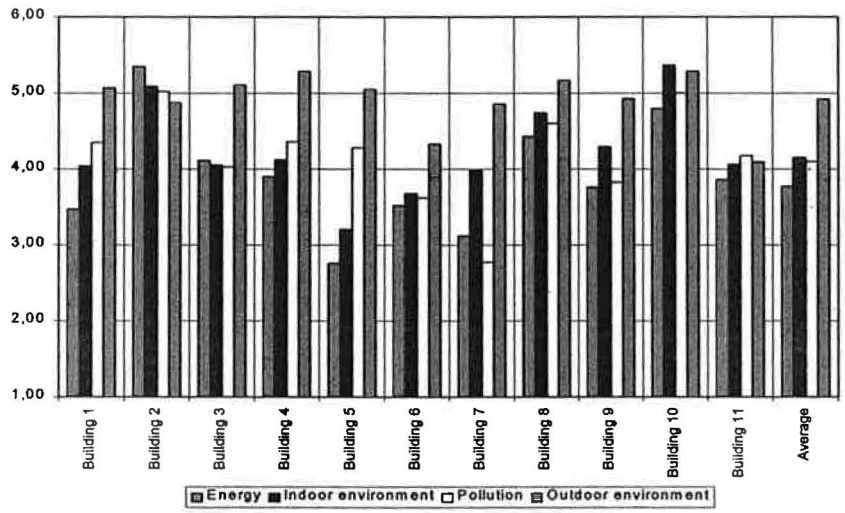

Figure 2 EcoProfiles - results from classification of 11 buildings.

The assessor group was comprised based on criteria of sufficient total expertise in such technical disciplines as energy, indoor climate and building technology. The classification of the buildings in the design phase was done on the basis of drawings, bid tenders, building programs and other written documents plus interview with consulting engineers and architects. For existing buildings the survey was done by the assessors in the course of a single day. It is easiest to base classification on readily available written documentation, such as project descriptions, building descriptions or building notices. Sadly most of the information in such sources is at variance with reality. For newer buildings this may be because changes have been made during the design phase and building phase, whilst for older buildings drawings and written information may never have been updated.

The pilot classification was done by assessors and maintenance people from the owner who sat down together and answered the questions on the classification form which could be answered without further ado. The remaining parameters were assessed and classified in the survey round of the buildings afterwards. In that survey such things as noise were measured, estimates were made of dust accumulation areas, and cleaning success was assessed. Classification was based on sampling of a selection of rooms and floors.
For one of the pilot buildings the reproducibility of the result was tested by two independent groups of assessors classifying the same building, figure 3. These two showed a 5 % disparity for energy and indoor environment, 8 % disparity for pollution and no disparity on the outdoor environment.

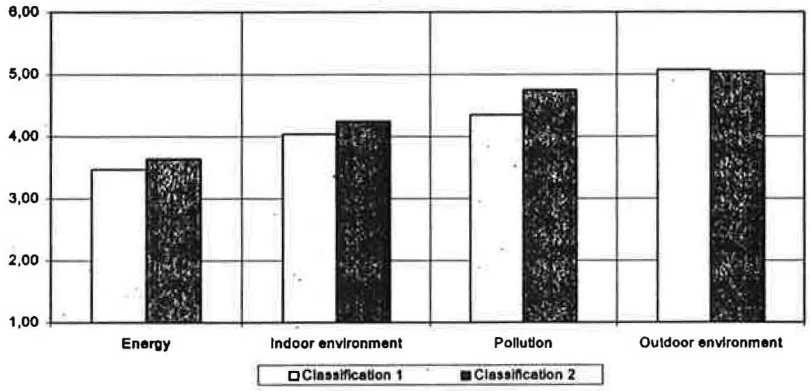

Figure 3 Independent classification, building 1.

An owner with a building which has low environmental rating can be obliged to perform renovation or modification to secure an acceptable lease. Similarly a high environmental rating in a lease or sale situation can motivate a higher price.

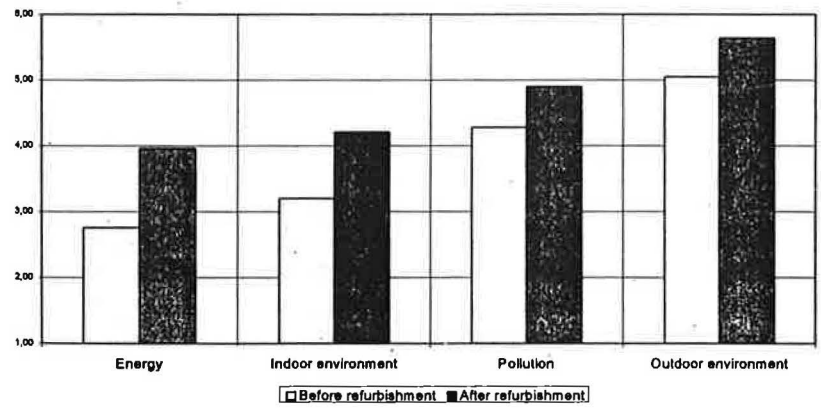

Figure 4 EcoProfile before and after refurbishment, building 4.

The results of classification according to the EcoProfile for buildings would make very good foundation for planning rehabilitation and refurbishment. Figure 4 shows impact assessment of an existing building and a simulated impact assessment for

the same building which was fine-tuned for various refurbishment alternatives, material selection, technical installations etc. The difference between the prior and the present situation proved a valuable aid in the planning process.

6. PROBLEMS AND NEED FOR REFINEMENT

It is important to use a large number of variables in the EcoProfile classification so that the results represent an overall environmental assessment of the building. For each variable there were three levels in the forms used for the pilot classification. For many of the variables three alternatives was inadequate as a result of which the classes failed to differentiate between good and poor and it is easy to opt for the middle category. There is clearly a need to distinguish between the building, operational and usage related factors.
The easiest way to assign weights is to give every variable in each main area a unit weight. That gives an environmental assessment in each area equal to the mathematical mean of all variables. Even if this zero weighting option may provide some indication on the level of environmental impact of the building, the EcoProfile method cannot rely solely on this approximation. A tool will be developed that can accept the raw data from an EcoProfile classification and thereafter weighting them according to a set of values for the type of building and relevant requirement specifications. Preparing the determinants and basis for various weighting models will be an important task to fine-tune the model. Regular updating and calibration of the method and acquired know-how will also be addressed and implemented in the guidance materials and documentation.

7. ACKNOWLEDGEMENT

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8. REFERENCES

[1] ØkoProfil for bygg. GRIPsenter, April 1996
[2] Environmental impact of buildings in Norway - Issues and assessment methods. Ola Stave. Vision EUREKA, Lillehammer, Norway 1994
[3] BREEAM/New Offices. Version 1/93 An environmental assessment for new office design. Building Research Establishment, England 1993